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STUDIES IN BLISTER BLIGHT CONTROL

VII. POWER DUSTING WITH "CUPROSANA" DUSTS CONTAINING 2, 4 AND 6 PER CENT. OF COPPER

By

C. A. Loos

In 1950 Dr. Dike of Messrs. Universal Crop Protection Limited, brought out to Ceylon his prototype "Whirlwind" power dusting machine which had been designed primarily for use with the same Company's "Cuprosana" fungicidal dusts containing various percentages of copper in the form of the oxychloride. Dr. Dike's preliminary experiments indicated that power dusting might be economically possible for blister blight control especially on areas too steep for knapsack spraying or where water supplies present a major problem. The "Whirlwind" duster can be mounted for transport on an open van for dusting along car roads, or when fitted on a trolley is sufficiently manoeuvrable to be taken along ordinary estate paths. A full description of this duster and its use on tea plantations has already been published by Dr. Dike in the Tea Quarterly (1).

The experiment reviewed in the present article was designed to test out the efficiency of the "Whirlwind" duster in the distribution of "Cuprosana" dust and the effectiveness in disease control of dust formulation containing 2, 4 and 6 per cent. copper during the south west monsoonal months. The limit of 6 per cent. copper in the dust was decided on both for economic reasons and on account of the possibility of excessive copper contaminations in the made tea should higher concentrations be employed. Application rates were fixed at 5 lbs. of dust per acre at 5 day intervals for reasons of general agricultural practice.

The area selected for the experiment was a tea field on the upper Abbotsford Division of Dessford Group, Nanu Oya (elevation approximately 5,000 ft.). The field lies on a south-westerly facing hillside with fairly low-lying and open country for miles in front of it. The position was such as would permit south-west monsoonal winds, during the normal monsoonal weather, to blow over the selected area without obstruction or deflection. In other words every attempt was made in the selection of a site over which dust could carry for fairly long distances, when supported by a south westerly originating wind.

A cart road for a short distance and its continuation as a foot path divided the area selected for the experiment into two parts. The dusted plots were laid out above the road and footpath while the unprotected plots, required for comparative purposes as to the incidence of disease during the experimental period, were sited below the road to the windward side so as to avoid any carry over of dust during the dusting operation.

Above the road and footpath three areas of approximately five acres each were selected and in each 5 acre block a rectangular plot of one acre (325 ft. long and 134 ft. wide) was wired off. The 325 ft. boundary was set running S.W. to N.E. to ensure, if possible, an even dust cover with winds blowing from a south-westerly direction. Other one acre plots, which remained untreated throughout the experiment, were wired off below the road and footpath.

The plots were treated as follows :—

Plot No. 1 — Protected with " Cuprosana " 2% copper dust applied at the rate of 5 lbs. per acre every 5 days.

Plot No. 2 — Protected with " Cuprosana " 4% copper dust applied at the rate of 5 lbs. per acre every 5 days.

Plot No. 3 — Protected with " Cuprosana " 6% copper dust applied at the rate of 5 lbs. per acre every 5 days.

Plot No. 4, Plot No. 5 — No treatment (unprotected).

From a point midway along the basal wire of each plot to be dusted wooden posts, 4½ ft. long, were planted 1½ ft. into the ground, at points 25, 50, 75 and 100 yards along the length of the plot. A few minutes prior to each dusting operation glass plates, of known surface area,were placed on top of these posts which stood a few inches higher than the surrounding tea bushes. After the dust clouds had settled the glass plates were collected and brought back to the laboratory for estimations of the amount of copper deposited at the different distances from the dusting machine.

The experiment commenced at the begining of May and concluded on October 15th, when the south-west monsoonal period was over.

Dustings and Copper Distribution

At the commencement of the experiment it was decided that all dusting operations should be along the road or footpath, even if wind conditions were not sufficiently strong to carry the dust cloud over the entire plot. Attempts to give a cover on the few occasions when winds were not sufficiently strong to cover the selected areas would have complicated the experimental results.

At each dusting, which was planned for five day intervals, 25 lbs. of each dust formulation were applied through the " Whirlwind " machine. In practice, however, the intervals between dustings sometimes ranged from four to six days when the fifth day fell on a Sunday. On most occasions an application of dust followed a day or two after a plucking while the next application was three to four days before the subsequent pluck, although on a few occasions it was applied two days before plucking.

The decision was made to try to cover each five acre block with 25 lbs. of dust, in which operation the experimental area of one acre should receive its required 5 lbs. quota. In practice, however, the machine operator, unconsciously perhaps, exhibited a tendency to settle a cloud of dust with the one acre experimental area as his target. Under the conditions of the experiment, therefore, this area was more effectively dusted than the complete five acre block.

Plots 1 (2% " Cuprosana ") and 3 (6% " Cuprosana ") were on all occasions more satisfactorily dusted than plot 2 (4% " Cuprosana ") as the dust clouds appeared to sweep fairly evenly over the two former plots. The 4% " Cuprosana " plot, due to a ravine along one side, suffered from changing wind currents. One corner at the extreme top of this plot often received no dust at all. This, viewed in connection with the results of the dust carry experiments in the Talawakelle railway tunnel, means very little as it is now known that a negligible amount of copper in this dust formulation carried to 300 feet. (2).

Table 1 shows the results of copper estimations, expressed as residues on the glass plates and on samples of fifty third leaves (leaves not usually plucked for manufacture), carried out during the course of the experiment (June—end of September). There were six dustings in each month.

Table 1. *Laboratory estimations of copper residues on plates and third leaves from collections made at varying distances from point of dustings. Copper expressed as parts per million on the leaf dry weight.*

	AVERAGE OF SIX DUSTINGS PER MONTH								Average for 24 dustings	
	June 1951		July 1951		Aug. 1951		Sept. 1951			
	Leaves	*Plates	Leaves	*Plates	Leaves	*Plates	Leaves	*Plates	Leaves	*Plates
2% Cuprosana at										
25 yards	63	37	58	51	42	27	93	47	64	41
50 „	22	23	25	26	27	21	24	17	25	22
75 „	14	16	12	18	11	14	12	11	12	15
100 „	9	17	8	14	7	11	12	11	9	14
4% Cuprosana at										
25 yards	72	42	76	61	91	58	86	81	81	61
50 „	27	21	22	32	51	33	39	45	35	44
75 „	12	18	26	13	35	16	30	15	26	16
100 „	11	18	11	12	18	9	8	10	12	15
6% Cuprosana at										
25 yards	194	79	90	55	112	102	80	77	109	105
50 „	95	75	84	52	69	49	37	27	71	51
75 „	69	47	51	36	42	24	20	14	46	30
100 „	27	28	28	18	40	18	16	12	28	19

**The equivalent values in parts per million on the leaf dry weight for the plate estimations given in this table have been calculated by multiplying the total copper in micrograms by 1.5625. Plate size—4 inches × 4 inches.*

Dependence solely on wind to carry the copper dusts appears to results in unevenness of distribution and a fall in the amount of copper deposited, as the distance from the machine increases. Although the amount of copper deposited at 25 yards from the machine increases with the higher percentage of copper in the dusts applied these increases are not directly proportional to the strengths employed. For instance, 4% " Cuprosana " dust did not deposit twice as much copper as the 2% dust nor did 6% dust give a deposit three times as much as the 2% dust. At 50 yards from the machine there was a very considerable fall in deposited copper when compared with the deposits at 25 yards. At the 50 yards point 4% " Cuprosana " gave, for the average of 24 dustings, twice the amount of copper on glass plates as the 2% dust. At the 75 yards point the 6% dust gave twice the amount of deposited copper as both the 4% and the 2% dusts, which at that range were equal. At 100 yards range there was nothing to choose between the three concentrations—all were almost equally low for deposited copper. From the copper distribution angle the 4% dust was better than the 2% and the 6% better than the 4% dust. These observations are similar to those recorded in the Talawakelle railway tunnel experiment (2).

Weather conditions at the time of application largely determine the amount of copper deposited as residue on leaves or plates. Throughout the Dessford experiment, copper residues immediately after application never exceed 194 p.p.m. with the 6% dust, 110 with 4% and 93 with 2% at points 25 yards from the machine. At distances further away the deposited copper fell far below those figures.

Estimations of total copper from leaf used for manufacture was made from each of the experimental plots at each plucking (Table 2). For estimating the copper as residues 25 p.p.m. should be deducted, as the inherent copper content of the undusted tea was in the region of 25 p.p.m.

Table 2. *Copper estimations (expressed as total copper) on dried tea at pluckings between 4th June and 8th October,* 1951.

Plot No.	Treatment	Copper parts per million
1	2% Cuprosana*	36
2	4% Cuprosana*	38
3	6% Cuprosana*	51
4	Unprotected	25
5	Unprotected	25

**It should be borne in mind that the heaviest dust deposits in the region of 0—25 yards from machine contribute chiefly to the total estimation over the one acre plot.*

Weather Conditions

The south west monsoon broke on 29th May with a rainfall over the 24 hours of 1.90 inches. During the period 29th May to 25th June the rainfall of 54.91 inches was probably an all time record on Dessford Group. Over one inch of rain was recorded on each of 21 days. Besides retarding new growth of leaves susceptible to infection, the heavy rains created conditions unfavourable to the disease. During the period 26th June to 26th July conditions were ideal for the building up of blister infections but the advent of sunshine and rainless days, from 27th July to 3rd August, reduced a potentially severe attack to a low level. Thirteen rainless days sufficiently staggered through August continued to keep infections in check. A further period of eight days continuous sunshine from August 27th to September 4th completely eliminated the possibility of a severe blister attack developing in September. Control of the disease in the experiment described has therefore to be assessed under conditions of this season only, which were not sufficiently severe for conclusive results when compared with the more disease favourable weather of prolonged mists and light rain experienced in past years.

Estimation of Blister Blight Control

At each plucking 50 samples of flush points (bud and 3 fully opened leaves) were collected at random at points 25, 50, 75 and 100 yards from the plot base line. From these samples counts were made of blister infections (translucent spots and white blisters) formed on the oldest leaf. In addition infected flush points were

estimated as a percentage of the 50 flush points collected. Table 3 shows the results of these estimations for the period 14th June to 25th July 1951, during which time blister blight was at its peak.

Table 3. *Blister infections (mean of 50 samples) from recordings at 5 pluckings (14th June—25th July, 1951).*

Plot No.	Treatment	Distance from base line of plots : yards	Average number of blisters per third leaf			Percent infected flush points		
1	2% Cuprosana	25	1.41			72		
		50	0.88			61		
		75	1.16			65		
		100	1.23			74		
2	4% Cuprosana	25	0.70			38		
		50	0.96			56		
		75	0.84			60		
		100	1.08			68		
3	6% Cuprosana	25	0.22			20		
		50	0.41			34		
		75	0.42			34		
		100	0.63			49		
4	Unprotected	25	2.18			78		
		50	1.89			78		
		75	2.15	2.10		70	74	
		100	2.17		2.03	70		73
5	Unprotected	25	2.20			76		
		50	2.02	1.96		73	72	
		75	1.85			69		
		100	1.77			72		

Table 3 should be examined together with Table 1, in which the falling off of copper deposits at progressive distances from the point of dusting is tabulated.

All the dusted plots, under the weather conditions experienced during this season, showed control superior to the unprotected plots. The 2% dust has obviously given light control over the experimental area, but the degree of control achieved was insufficiently high. The 4% dust gave better control than 2% but, even at 25 yards from the point of dusting, control was far less effective than that achieved with 6% dust over the same range. A progressive decline in protection can be noted as the distance from the dusting point increases when 4% dust was used. In the case of 6% dust, however, the range of effectiveness was further, although there appears to be a marked falling off in control at the 100 yards limit. Visual observations on 10 different dates are given in Table 4.

Table 4. *Visual estimations of control.*

Treatment	Distance from base line	DATE OF OBSERVATION									
		4/6	25/6	4/7	6/8	16/8	27/8	6/9	17/9	8/10	18/10
2% Dust	25 Yards	1	1	1	2	2-3	2-3	2-3	2-3/4	2	2
	50 ,,	1	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2	2
	75 ,,	1	2	2	2-3	2-3	2-3/4	2-3/4	2-4	2-3	2-3
	100 ,,	1	2	2	2-3	2-3	2-3/4	2-3/4	2-4	2-3	2-3
4% Dust	25 Yards	1	1	1	1	2	2	2	1	1	1
	50 ,,	1	1	1	2	2	2	2-3	2	1	1
	75 ,,	1	2	2	2-3	2-3	2-3/4	2-3	2-3	1	2
	100 ,,	1	2	2	2-3	2-3	2-4/5	2-3/4	2-3	2	2
6% Dust	25 Yards	1	1	1	1	1	1	1	1	1	1
	50 ,,	1	2	1	2	2	2	1	1	1	1
	75 ,,	1	2	1	2	2	2	2	2	2	1
	100 ,,	1	2	1	2	2	2	2	2	2	2
Unprotected	25 Yards	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2-4	2-3	2-3
	50 ,,	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2-4	2-3	2-3
	75 ,,	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2-4	2-3	2-3
	100 ,,	1	2	2-3	2-3	2-3/4	2-3/4	2-4	2-4	2-3	2-3

Key

0 — No leaf blisters or die-back
1 — Leaf blisters few
2 — Leaf blisters fairly numerous
3 — Die-back slight
4 — Die-back fairly severe
5 — Die-back severe

A marked feature in the dusted plots was the screening or shielding effect of the larger bushes. Weak plants and bushes lower in height than the bushes in front of them showed evidence of fairly severe die-back indicating that little or no dust was deposited. Such shielding action was apparent even a few yards from the dusting points.

Yield Records

No undue reliance should be placed on these records (Table 5) as the plots were not laid out on a randomised basis or replicated. There has, however, been some indication that control gave increased yields in comparison with the areas left unprotected.

Table 5. *Crop returns for dusted and unprotected plots.*

Period		25/4-25/6		26/6-27/8		28/8-27/9		25/4-27/9
Plot No.	Treatments	Yield as lbs. dry matter per acre	Order of merit	Yield as lbs. dry matter per acre	Order of merit	Yield as lbs. dry matter per acre	Order of merit	Order of merit
1	2% Cuprosana	119	5th	90	3rd	87	5th	5th
2	4% Cuprosana	138	4th	102	2nd	105	3rd	2nd
3	6% Cuprosana	156	2nd	124	1st	115	1st	1st
4	Unprotected	153	3rd	74	4th	105	3rd	4th
5	Unprotected	161	1st	66	5th	107	2nd	3rd

Plots 4 and 5 (unprotected) which were placed in order of merit as 3rd and 1st for the plucking period 24th April to 25th June, before loss due to blister blight was possible, take 4th and 5th place on the result of pluckings between 26th June and 27th August. The 6% dust plot moves up from 2nd place to a very good 1st, while the 4% plot takes 2nd place and the 2% dust plot moves up from 5th to 3rd position. This order of merit corresponds very closely to the control achieved by protection (Table 4).

The falling off in blister intensity, due to improved weather conditions, from the end of August onwards is reflected in the yields for the period 28th August to 27th September. The 6% dusted plot continued to give the highest yields, while the unprotected plots 4 and 5 rose from 4th and 5th positions to 2nd and 3rd. The 4% dusted plot, though it has fallen back in yield capacity, ties for 3rd place with the unprotected plot No. 4. The 2% dusted plot goes back again to the last position from 3rd place which it held at the end of the blister blight season.

Summary

This power dusting experiment to test the efficiency of " Cuprosana " copper fungicidal dusts of 2%, 4% and 6% copper contents was conducted under south-west monsoonal conditions which were not fully conducive to severe blister blight attacks. The abnormal weather during the 1951 south-west monsoon created conditions which kept attacks down to a fairly low level, thus preventing a sufficient build up of mature blisters to cause the widespread damage we have been accustomed to at this season of the year. Under the conditions of the experiment there have been definite indications that fairly effective control of blister blight is possible with 4% and 6% " Cuprosana " dusts, if an even coverage is possible. Relying on wind distribution of the 6% dust in conjunction with the " Whirlwind " duster distances further than 50 yards were protected to only a limited degree. Lighter protection was afforded with 4% " Cuprosana " dust but for a shorter range only. 2% " Cuprosana " gave inferior control throughout the plot. When the " Whirlwind " duster is used for application of dusts effective control would appear to be limited to a swathe of not more than 50 yards wide with 6% dust and 25 yards wide with 4% dust.

Acknowledgments

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The numerous copper determinations were made by Dr. Haworth, Agricultural Chemist of the Tea Research Institute of Ceylon.

Mr. E. S. Rajiah, Field Assistant to the Plant Physiologist, was in charge of the collection of all data and conducted the dustings. I have pleasure in acknowledging his efficient help.

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(1) Dike, H.—Mechanical Dusting against Blister Blight, *Tea Quarterly*, XXI, Parts II/III, pp. 29-35, 1950.

(2) Haworth, F.—Distribution of Copper Containing Dusts, *Tea Quarterly*, XXII. Part III, pp. 97, 1951.

STUDIES IN BLISTER BLIGHT CONTROL

VIII. TRIALS CONDUCTED WITH THE "MICRON" POWER SPRAYER IN CONNECTION WITH THE APPLICATION OF OIL-BASED COPPER FUNGICIDES

By

C. A. Loos

Introduction

At the end of 1950, Mr. E. J. Bals, of Messrs. Clean Crops Limited, arrived in Ceylon bringing with him a prototype "Micron" power spraying machine, which he had developed for the low volume application of oil based formulations at rates of less than 1 gallon per acre. During his short stay in Ceylon, Mr. Bals carried out a number of preliminary trials with his machine and succeeded in obtaining fairly effective distribution of atomised light oils ; the best results being obtained with the grade known as "spindle oil". Satisfactory results with emulsions were not obtained in these trials.

Mr. Bals also tried out on a few occasions a copper napthenate fungicide in an oil emulsion. This particular formulation caused undesirable tainting of the manufactured tea.

For the trials under review, which were carried out during the south west monsoon period of 1951, the prototype "Micron" sprayer, slightly modified in construction by our engineer on Mr. Bals's instructions, was used. The modifications were chiefly confined to the installation of Mr. Bal's new type atomiser and a flexible delivery tube.

Fungicides

Five proprietary formulations were available for trial. It was previously decided that the application rate should be fixed at 3/4 th. gallon per acre and that the final mixture should contain approximately 2 ounces of copper in the metallic form in each 3/4 th. gallon. This procedure was followed except where otherwise stated.

The mixtures were made up as follows :—

(i) **Copper napthenate.**— 80 ounces of formulation diluted with 40 ounces of water.

(ii) **Buisol.**—(Messrs. Boots Pure Drugs, Ltd.)
60 ounces of formulation made up with 60 ounces of water.

(iii) **Ialine.**—(Messrs. Burt Boulton & Haywood, Ltd.)
At first used undiluted. After two applications diluted at the rate of 4 parts Ialine with 1 part water (on instructions received from the makers).

(iv) **Cuproil**—(Messrs. Universal Crop Protection, Ltd.)
Prepared for field application as follows :—
8 ounces Cuproil, 60 ounces Foliol, 52 ounces water.

(v) **Clean Crops fungicide.**—(Messrs. Clean Crops. Ltd.)

One pint was used undiluted over 1/6th of an acre, as supplies were limited. Clean Crops fungicide contains approximately 10 per cent. copper in an oil base.

Experimental Area

The field selected for the experiment was on a north-easterly facing hillside. Under normal south-west monsoon conditions it was expected that the prevailing wind would be due north-east. The upper boundary of the plots was a car road along which the " Micron " sprayer was worked. Each of the five plots was 50 yards wide and 100 yards deep (approximately one acre) and separated by guard plots also of the same size. The guard plots were set up to avoid spray drift and spray contamination between treatments.

In the line of anticipated wind direction in each plot, except in the case of copper napthenate, posts were set up 25, 50, 75 and 100 yards distant from the road Immediately prior to each spraying glass plates, of known surface area, were placed on these posts for estimation, in the laboratory, of copper deposits.

Table 1. *Copper deposits expressed as parts per million on glass plates* following spraying through the " Micron " Sprayer.*

Formulation	DATE							
	14/7	24/7	3/8	10/8	20/8	29/8	7/9	17/9
Buisol								
25 Yards	9	20	40	32	19	75	26	9
50 „	7	64	12	8	4	3	5	3
75 „	5	110	6	8	4	3	4	3
100 „	5	8	5	5	4	4	4	6
Ialine								
25 Yards	5	22	13	14	11	5	4	23
50 „	4	8	11	7	5	3	4	10
75 „	4	8	11	25	6	6	4	4
100 „	5	8	9	9	4	3	5	3
Cuproil								
25 Yards	57	158	65	55	192	5	6	180
50 „	18	21	7	8	120	3	5	40
75 „	5	6	5	5	19	3	4	10
100 „	10	5	4	5	10	5	4	4
Clean Crops								
25 Yards	5	20	4	43	22	5	8	6
50 „	4	7	5	3	10	3	4	4
75 „	5	7	5	4	8	3	4	3
100 „	5	13	7	4	5	2	4	7

**Copper deposits are expressed in terms of parts per million on leaf dry weight for comparison purposes. These values are obtained by multiplying the total copper per plate in micrograms by 1.5625. Plate size- 4 inches x 4 inches.*

Table 1 shows the copper deposits on the plates collected after each spraying between 14th July and 17th September. In relation to these figures it should be borne in mind that figures below 5 p.p.m. may be ruled out as due to experimental error. Where deposits of copper are estimated from catches made at the time of application figures above 100 p.p.m. of copper are probably required for the effective control of blister blight when a period of 8—10 days intervenes between spray applications.

Spray Distribution and Wind Condition

During this year's south west monsoon, when large scale dusting has been in operation, it became increasingly evident that, in the up-country districts, the wind although arising from the south-west, can change direction considerably over even small areas. Accordingly, unless fields are very extensively roaded, in all directions, it becomes a physical impossibility to cover evenly any one particular field or area. In the case of power dusting this difficulty may be partially overcome by watching the carry of the dust and dusting the areas it has not been possible to cover with the aid of hand dusters. In the case of the " Micron " sprayer the carry of the fungicide mist could not be observed beyond 20 yards from the machine, even when the wind was favourable and blowing continuously in one direction. The distance to which the spray carried could only be observed from deposits on glass plates. It may be ruled out as unlikely that estates can find the time to lay out glass plates, in sufficient numbers, to observe just where and to what extent a field had been adequately sprayed. The ever-changing wind currents and the normal road system on upcountry tea estates would make spraying of a reasonably wide swathe improbable. The size and weight of the " Micron " sprayer are, also, disadvantages which cannot be lightly overlooked in large scale operations. On the trial plots it was evident that an even and effective cover with fungicides was not possible at any time during the south west monsoon months.

Results of Spraying

Of the fungicides tested through the " Micron " sprayer only Buisol and Cuproil can be considered to have given fair distribution up to 25 yards from the spraying position. Judging from the results of the copper analyses for August 20th, Cuproil, given perfect conditions of wind currents, gave good distribution up to 50 yards (see Table 1). In dry spells during the monsoon the ever-changing wind currents made cover impossible throughout the plots (cf. results on 29/8 and 7/9). Clean Crops fungicide and Ialine, though easy to handle and atomise, gave indifferent results even at 25 yards.

Copper napthenate.—This preparation gave rise to very severe tainting. Scorch appeared on both old and young leaves after 4 applications of fungicide. There was no apparent control of blister blight beyond 4—5 yards from the spraying point.

Buisol.—For the first 3 applications there was no evidence of scorch on the tea leaves. From the 4th application onwards scorching became more and more apparent, especially in the first few yards from the spraying point. There was fair control of blister blight from 0—20 yards. Beyond that no control was evident.

Ialine.—Severe scorching of both young and mature leaf was evident after the first application. The Ialine sprayed plots at the end of the experiment showed severely defoliated tea up to 5 yards. Beyond, scorching effects diminished rapidly. There was no apparent control of blister blight.

Cuproil.—This formulation showed no control of blister blight. There were no signs of scorch until after 6 applications when older leaves 0—5 yards from the spraying point showed scorch blotches. Scorching was most apparent on leaves which received spray on the under surface.

Clean Crops fungicide—At no time did leaves scorch. There was slight control of blister blight between 0—5 yards, beyond that no control at all.

Conclusions

None of the fungicides tested appear suitable for the control of blister blight. Except for Clean Crops fungicide all other formulations tested caused scorch and injury to leaves. The gradual building up of conditions conducive to scorch, as applications increase in number, should be considered before long term spraying programmes with oil-based fungicides are contemplated for tea. Furthermore the reaction of tea to repeated oil applications over a number of years should be known for a certainty, before oil-based formulations can be safely recommended. Judging from the condition of the tea which received the spray, of at least one of the formulations, the risks involved can be very serious.

As a practical proposition on Ceylon up–country tea estates it would appear that the " Micron " sprayer in its present form is unsuitable, even if a non-tainting, non-scorching oil-based fungicide can be developed.

NOTE ON PHOSPHATE AVAILABILITY AFTER GUATEMALA GRASS

By

F. Haworth

On one of the St. Coombs experimental clearings, which had been under Guatemala grass for a period of two years, it was found that on removing the grass it was impossible to establish leguminous green manures quickly.

The rapid establishment of a good cover of green manure bushes is essential after removing the grass to prevent undue heating of the soil by exposure to strong sunshine.

The trouble was traced eventually to lack of available phosphate in the soil. Since the grass had received very considerable amounts of mixed fertilizer during its two years of growth it would appear that all the available phosphate in the soil had been taken up by the grass and stored in the leaves and roots.

Consequently it seems advisable, when planting green crops, in areas which have been rested under Guatemala grass, to supply adequate amounts of inorganic manures to ensure good establishment. Probably the best way of applying the manure, to minimise weed growth, is to draw two parallel drills, some 3 inches apart, placing the seeds in one drill and the manure mixture in the other. A satisfactory manure mixture for this purpose would be :—

Sulphate of ammonia	—	3 parts
Superphosphate (20%)	—	2 parts
Muriate of potash (50%)	—	1 part,

applied at a rate of 1 cwt. per acre.

REPORT OF THE WORK CARRIED OUT BY THE TEA RESEARCH INSTITUTE IN CONNECTION WITH THE CONTROL OF THE BLISTER BLIGHT DISEASE OF TEA DURING THE PERIOD 1ST APRIL, 1950, TO 31ST MARCH, 1951.

INTRODUCTION.

On the 10th November, 1949, the First International Symposium on Blister Blight Control, which had been organised by the Tea Research Institute of Ceylon, was held in Nuwara Eliya (1). At this meeting, which was attended by representatives of all the principal tea producing areas of the world and several world famous organisations specializing in large scale crop protection, it was soon recognized that the work carried out by the Tea Research Institute in Ceylon, in connection with the control of this most serious leaf disease of tea, was far in advance of that being done elsewhere. Furthermore, it was agreed that the Tea Research Institute now possessed sufficient fundamental knowledge of the causative organism (*Exobasidium vexans*) and its susceptibility to certain fungicides to warrant our embarking on large scale trials designed to explore the possibilities of achieving successful and economic crop protection on an estate scale in view of the extreme difficulties of application which would inevitably arise on account of adverse weather and difficulties of terrain.

The ordinary resources of the Tea Research Institute were, however, entirely inadequate to permit the expansion of our experimental work on blister blight control on the scale then considered necessary if large scale crop protection methods were to be developed in time to save much of the more seriously affected tea areas. Accordingly a " Report on Blister Blight Disease in Ceylon Tea Plantations " (1), reviewing the work done to date and giving our recommendations for future research work on methods of control, was prepared and submitted to the Tea Controller on 28th November, 1949. In this report we estimated that the provision of special funds for blister blight control work, averaging Rs. 150,000/- per annum for the next four years, would be required. Our report was accepted and on 4th April, 1950, a resolution moved by the Hon'ble Minister of Agriculture & Lands, was passed by the House of Representatives authorising a sum of Rs. 150,000/- to be paid from the surplus available in the Tea Control Fund at the end of the control year 1949-1950 to the Tea Research Institute to finance the campaign against blister blight.

The present report accordingly deals with the blister blight control work carried out by the Tea Research Institute during the Tea Control year 1st April, 1950, to 31st March, 1951.

PROGRESS ACHIEVED.

Probably the most important single experiment carried out during the period under review was that on Kataboola Group, Kotmale, in which 200 acres of tea recovering from pruning during the south west monsoon were protected by wet spraying with a copper fungicide (2). This experiment was completely successful and effectively demonstrated that a satisfactory degree of protection on an estate scale was not only possible but also economically practicable.

A further important result arising from this and other experiments was the discovery that spraying with copper fungicides during quite heavy monsoon rain was still capable of affording a reasonable degree of protection. This discovery is likely to prove of considerable value in protection work on other crops besides tea, since it had previously been the general opinion that spraying during rain would prove useless.

Many other field experiments in connection with the application of crop protection and agricultural control methods to tea in bearing were, of course, also carried out during the south west monsoon season. These will be briefly described later on in this report. Mention, however, must be made here of the fact that experiments carried out on St. Coombs effectively proved that it was equally possible to protect tea in plucking on a field scale by means of wet spraying with copper fungicides. In spite of the success of these experiments it was still not possible for us to advocate the adoption of spray protection for tea in bearing owing to uncertainty as to whether made teas containing copper residues would be accepted by importing countries. Fortunately this matter had already been taken up very urgently with the Metallic Contamination Sub-Committee of the Food Standards Division of the U. K. Ministry of Food and in October, 1950, we were informed that the U. K. authorities were prepared to allow us a temporary tolerance of 150 parts per million of copper.

On receipt of this information no further purely technical difficulties remained to prevent the protection of Ceylon tea against blister blight. Accordingly, the date of our Ninth Biennial Conference was advanced to the 1st December, 1950, so that all available information could be given to the industry to enable an early start to be made in the adoption of crop protection measures. Much of this information has now been published in the form of technical papers in the *Tea Quarterly*, and to which reference is made where relevant.

GENERAL SURVEY OF THE YEAR'S WORK

Crop Protection during Recovery from Pruning.

1. **Wet Spraying.**—Wet Spraying of the main 200 acres experiment on Kataboola Group has already been described (2). This experiment was, however, a major undertaking and additional assistance was essential. Accordingly, Mr. N. M. Lindsay was borrowed from the Colombo Commercial Company Ltd., and stationed at Kataboola for the early stages of the experiment, whilst Mr. C. L. Scoles, who was seconded to us from Plant Protection Limited, rendered invaluable assistance during the concluding stages.

Parallel with the Kataboola experiment, a number of different estates in bad blister areas in several different districts agreed to co-operate with us by spraying areas of about 50 acres each of tea pruned down into the south west monsoon. In connection with these experiments training courses for the Superintendents were held in June and for the spraying labourers in July 1950. All these subsidiary experiments were completely successful and the practicability of protecting tea recovering from pruning by wet spraying firmly established (2.).

2. **Dusting.**—An area of two acres of St. Coombs tea, pruned at the end of July, was successfully protected with Cuprosana dust containing 6% of copper (3).

Crop Protection during Plucking.

1. **Wet Spraying.**—Two main experiments concerned with the protection of tea in plucking by means of wet spraying were in operation on St. Coombs during the year (4.). These were :-

(*a*) The St. Coombs No. 9 Field Crop Protection Experiment. This experiment was started on tea pruned down in December, 1948 and is still continuing. It provides a comparison of the protection afforded by wet spraying at 7 and 14 days intervals.

(*b*) The St. Coombs No. 8 Field Crop Protection Experiment. This was started on tea pruned down in December, 1949. The experiment is on a much larger scale than the No. 9 Field Experiment and compares the effects of protection at 10 day intervals during both the south west and north east monsoons and during the south west monsoon only. In both cases the cost of wet spraying has proved to be entirely economic in relation to the amount of extra crop obtained, while the copper content of the made tea has remained well within the permitted limit.

2. **Dusting.**—Preliminary experiments using the " Whirlwind " power duster and " Cuprosana " dusts were carried out on Mattakelle and Castlereagh estates in co-operation with Dr. H. Dike of Universal Crop Protection Limited (5). The results of the Castlereagh experiment appeared so promising that a demonstration for Visiting Agents and Senior-Superintendents was arranged in August, 1950. Subsequently a 200 acre dusting experiment, in which 2% " Cuprosana " dust was applied from the " Whirlwind " duster, was carried out on Kataboola Group during the north east monsoon period 1950-51. Weather conditions, however, proved most unsatisfactory and the experiment merely served to indicate how much we still had to learn about crop protection by dust on an estate scale (6).

Trials with Fungicides.

During the year the Shell Laboratories, Amsterdam, offered their co-operation and agreed to send out Dr. J. W. Pfaeltzer to work at the Tea Research Institute during the south west monsoon period of 1950. While at St. Coombs, Dr. Pfaeltzer carried out an extensive series of screening trials with some 188 formulations of 58 different fungicides. The fungicides tested included all those commercially available as well as many new experimental products. As had been expected copper containing products generally proved to be the most effective of the commercial products. (7).

Crop Protection by Modified Agricultural Methods.

In spite of our major pre-occupation with crop protection by means of fungicides, the possibilities inherent in achieving some degree of control by modifications of existing agricultural practices were not lost sight of and several experiments in this connection were laid down on Kataboola and elsewhere. (8) (9). Much further work still remains to be done but there are many indications which promise well for the future.

Copper Residues.

Much experimental work both in the laboratory and the field has been carried out in connection with the copper residues found in the made tea as a result of the application of copper fungicides. (10) Here again much further work still remains to be done but, provided estates adhere to our published instructions, we have no reason to suppose that the permitted tolerance of 150 parts per million of copper will be approached, let alone exceeded.

Establishment of Workshop.

An Engineer, Mr. J. Landreth, was engaged in March, 1950 and a new Workshop was built and equipped during the course of the year. Although ordered early in 1950, delivery of many of the machine tools was much delayed and their cost cannot, therefore, be included in the financial year covered by this report.

Although working under difficulties much of the time, the Workshop has already proved of the greatest value in connection with the testing and modification of crop protection equipment, whilst much useful apparatus has already been

designed and prototypes produced by Mr. Landreth. The Engineering Department, does not, however, possess any equipment for testing strengths of materials and accordingly can not express any opinion regarding the wearing qualities or mechanical soundness of any commercial equipment examined.

Finance.

The audited accounts of the Tea Research Institute showed that at 31st December, 1950, a sum of Rs. 151,438,81 had been expended on the special blister blight account, leaving a debit balance of Rs. 1,438.81 in respect of the special contribution of Rs. 150,000.00 received from the Tea Controller. By the end of the tea control year further expenditure amounting to Rs. 10,594.84 had been incurred, leaving a debit balance as at 31st March, 1951, of Rs. 12, 033.65. The account is set out below.—

BLISTER BLIGHT ACCOUNT.

Special contribution received from Controller (August, 1950) ..		Rs. 150,000.00
LESS—**Expenditure to 31.12.1950.**		
Revenue Account	Rs. 86,764.74	
Capital Account	„ 64,674.07	„ 151,438.81
Debit Balance as at 31-12-1950. ..		Rs. 1,438.81
Expenditure 1st January to 31st March, 1951.		
Revenue Account	Rs. 10,425.83	
Capital Account	„ 169.01	Rs. 10,594.84
Debit balance as at 31-3-1951. ..		„ 12,033.65

ACKNOWLEDGEMENTS.

This report would not be complete without referring to the immense value the special contribution of Rs. 150,000.00 from the Tea Control Fund has undoubtedly been in speeding up Ceylon's fight to control blister blight. However, much further work still remains to be done, which will only be possible if the present scale of financial assistance is continued for several years to come.

Grateful acknowledgment must also be made to the Shell Company for sending out Dr. Pfaeltzer, to Plant Protection Limited for seconding Mr. Scoles to us, and to Universal Crop Protection Ltd., for Dr. Dike's pioneer work in connection with dusting.

Thanks are also due to the Superintendents, Agents and Directors of Kataboola Mattakelle and Castlereagh Estates, in particular, and of all other estates which co-operated in our pioneer experiments.

REFERENCES.

(1) *Tea Quarterly*.—Vol. XX, Pts. III-IV, December, 1949, (Symposium number).

(2) Portsmouth, G. B.—Crop Protection during Recovery from Pruning, *Tea Quarterly*, Vol. XXI, Pt. IV, p.11, Dec. 1950.

(3) Lamb, J.—Crop Protection by Wet Spraying compared with Crop Protection by Dusting. *ibid*, p. 44.

(4) Loos, C. A.—Crop Protection during Plucking, *ibid*, p. 16.

(5) Dike, H.—Mechanical Dusting against Blister Blight, Sections I & II, *Tea Quarterly*, Vol. XXI, Pts. II-III, p. 29, Sept. 1950.

(6) Haworth, F.—The Application of Crop Protection Methods, Pt. II, Dusting *Tea Quarterly*, Vol. XXI, Pt. IV, p. 27, Dec. 1950.

(7) Pfaeltzer, J. W.—An Evaluation of some commercially available Fungicides for the Control of Blister Blight. *Tea Quarterly*, Vol. XXII, Pt. II, p. 52, June, 1951.

(8) Loos, C. A.—Crop Protection by Modified Agricultural Methods, Pt. II. The Kataboola Loss of Crop Experiment, *Tea Quarterly*, Vol. XXII, Pt. IV, p. 38, Dec. 1950.

(9) Portsmouth, G. B.—Crop Protection by Modified Agricultural Methods, Pt. III, General Considerations, *ibid.* p.41.

(10) Haworth, F.—Crop Protection by Copper Fungicides, Pt. I, The Effect of Weather on Copper Residues. *ibid.* p. 28.

(Sgd.) G. B. PORTSMOUTH,
Acting Director.

Tea Research Institute of Ceylon,
St. Coombs, Talawakelle,
October 8th, 1951.

BLISTER BLIGHT CIRCULARS

At the Ninth Biennial Conference, which was held in Nuwara Eliya at the end of 1950, *it was announced that the Tea Research Institute intended to issue periodical circulars on matters of immediate interest in connection with the application of crop protection methods for the control of blister blight. These circulars would be sent free to all who registered their names with the Institute.*

Some eight of these circulars have now been issued. Accordingly, it seems likely that the list given below of the subjects already dealt with may be of value. Copies of most circulars are still available and can be obtained on application.

Ref. No.	Date Issued		Subjects covered
B.B./1	20-12-50	—	Crop protection equipment—wet spraying equipment.
B.B./2	13- 2-51	—	Practical wet spraying of tea in bearing—Spraying against blister blight by A. R. Williams. (Deals with boom spraying on Ragalla Estate)
B.B./3	16- 3-51	—	Training courses for superintendents. Copper fungicides. Large scale spraying with knapsack equipment. (Data from Downside Estate).
B.B./4	30- 4-51	—	Fungicide requirements for wet spraying. Copper contents of common fungicides.
B.B./5	4- 6-51	—	Notes on maintenance of wet spraying equipment. The maintenance of pressure-retaining knapsack spray equipment with special reference to " Four Oaks " and " Vermorel " models. 4-nozzle boom spraying.
B.B./6	24- 7-51	—	Charging of knapsacks from factory compressed air lines—safety precautions.
B.B./7	27- 9-51	—	Variation in density of copper fungicides.
B.B./8	6-10-51	—	" Four Oaks " battery knapsack sprayers, safety precautions.

MINUTES OF THE MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT 2.30 P. M. ON FRIDAY, 7TH SEPTEMBER, 1951, AT THE OFFICES OF THE PLANTERS' ASSOCIATION OF CEYLON, 113, STEUART PLACE, COLPETTY, COLOMBO.

Present.—Mr. R. C. Scott, C.B.E., (Chairman) ; The Director of Agriculture (Dr. A. W. R. Joachim, M.B.E.,) ; Messrs. W. Neal de Alwis, W. H. Attfield, R. M. Macintyre, A. D. McLeod, V. G. W. Ratnayake, M.P., M.B.E., Errol Jayawickreme, The Secretary to the Treasury (Mr. A. G. Ranasinghe, C.M.G., C.B.E., C.C.S.,) ; H. S. Hurst and G. B. Portsmouth (Acting Director and Secretary).

1. Notice convening the meeting was read.

Letters and messages regretting inability to attend were received from the Chairman, Planters' Association of Ceylon (Mr. R. C. L. Notley), The Chairman, Agency Section, Planters' Association (Mr. R. S. Davies), Mr. L. B. de Mel and H. de T. Wilkinson Kay.

2. The Minutes of the meeting of the Board held on 20th April, 1951, were confirmed without comment.

3. MEMBERSHIP OF THE BOARD & COMMITTEE.

(*a*) Board.

The Chairman tabled a letter dated 1st September, 1951, which he had received from Mr. L. B. de Mel tendering his resignation from the Board on account of ill health. He expressed the appreciation of the Board for the keen interest and the very valuable contribution made by Mr. de Mel as a member. On behalf of the Board he expressed the earnest hope that Mr. de Mel would make a speedy recovery and soon be fit to resume normal activities.

(*b*) Estate & Experimental Sub-Committee.

The Chairman reported that at the meeting of the above Committee held on the 1st September, 1951, Mr. P. B. Cruickshank had intimated that he was proceeding on long leave. The Committee recommended the appointment of Mr. S. Bolster to fill the vacancy. Approved.

(*c*) Mr. V. G. W. Ratnayake, M.P., M.B.E.,

The Chairman, on behalf of the other members of the Board, congratulated Mr. Ratnayake on his appointment as Parliamentary Secretary to the Minister of Posts and Telecommunications.

4. FINANCE.

(i) Auditors' Report & Audited Accounts for 1950.

The Chairman reported that a copy of the Auditors' Report and Accounts had been circulated. A memorandum on various points raised in the Report had also been sent out to members. The Report and Accounts had been carefully considered by the Finance Sub-Committee that morning. The Sub-Committee had unanimously recommended the acceptance of the Auditors' Report and Accounts.

He informed the members that the Institute's Balance Sheet was now presented in the form recommended by Mr. Kelly and accepted by the Board. It would be noted that the Capital Account was now incorporated in the Balance Sheet.

The Auditors' Report and Accounts for 1950 were accepted on the proposal of Mr. H. S. Hurst, seconded by Mr. R. M. Macintyre.

(ii) **T. R. I. Accounts to 30th June, 1950.**

The Chairman reported that the cess collections had averaged Rs. 64,530 per mensem which was a very satisfactory figure.

He said that although the St. Coombs Estate Working Account showed a loss of Rs. 30,706-61, the true position was a profit of Rs. 21,782-50. This was so because the 27,984 lb. tea made in June,but sold in July for Rs. 52,489-11, was not included in the accounts.

The Chairman announced that by the end of August, 1951 the yield of St. Coombs Estate had exceeded the total yield for the whole of 1950 by some 2,000 lbs.

(iii) **Blister Blight Account.**

The Acting Director (Mr. G. B. Portsmouth) explained that the contribution of Rs. 150,000/- for the year 1-4-51 to 31-3-52 could be expected as soon as a report on the past year's working had been sent to the Tea Controller.

5. SMALL HOLDINGS SERVICE.

Extension of Small Holdings Service.

The Chairman referred to the memorandum approved at the last meeting of the Board held on 20-4-51 and which set out the plan for the proposed extension of the small holdings advisory service.

The Acting Director said that in order to put the recommendations embodied in the memorandum into effect without further delay a number of decisions should be taken by the Board. These fell into two categories, namely, Finance and Staff, and as the financial implications had already been considered by the Finance Sub-Committee he suggested that they should be dealt with first. The Finance Sub-Committee had, that morning, decided to recommend the following proposals for approval by the Board.

(*a*) The revenue from the extra cess of 5 cents per 100 lb. tea exported to be formally voted to the Small Holdings Service for administration by the Director. The Director to have authority to transfer such amounts as he considered necessary to a Small Holdings Imprest Account, which would be operated on by the Officer-in-Charge of the Small Holding Service.

(*b*) A sum of Rs. 45,000 from general revenue to be voted annually to augment the Small Holdings Account. In the current year the balance of the total vote for Small Holdings, as at the date from which the new cess became operative, to be transferred to the Small Holdings Account.

On the proposal of Mr. McLeod, seconded by Mr. Ratnayake, the financial proposals above were unanimously approved.

The Acting Director's proposals relating to staff were then considered.

It was agreed that Mr. R. L. Illankoon be appointed Officer-in-Charge of the new Small Holdings Service. Proposed by Mr. W. Neal de Alwis and seconded by Mr. H. S. Hurst.

The Acting Director had earlier in his remarks referred to Mr. R. L. Illankoon as an officer eminently suited to this new appointment in view of his long experience of this class of work.

The subject of the appointment of a permanent Sub-Committee which would be responsible to the Board for all matters pertaining to the working of the proposed small holdings scheme was then taken up. It was unanimously agreed that the following should form the Sub-Committee :—Mr. V. G. W. Ratnayake (Member representing the Small Holders), Dr. A. W. R. Joachim (Director of Agriculture) and Mr. W. Neal de Alwis, together with the Director, T. R. I., and the Officer-in-Charge, Small Holdings Service.

6. LOW-COUNTRY SUB-STATION.

The Chairman reported that the repairs to Pembroke bungalow were almost completed and that Mr. Walter was expected to be in occupation shortly.

7. ELECTRICITY SCHEME.

The Chairman reported that in accordance with a previous decision of the Board, the Government Electrical Engineer had been asked to report on the St. Coombs Electricity supply service. A summary of his findings had been circulated to members. The Finance Sub-Committee had considered the matter that morning and their recommendation was that the 300 KVA scheme should be accepted, since this scheme would fully meet present needs and also provide for any expansion likely in the forseeable future.

The recommendation of the Finance Sub-Committee was approved on the proposal of Mr. de Alwis, seconded by Mr. Hurst.

8. STAFF.

Senior Staff.

The Chairman reported that :—

(*a*) the Superintendent, Mr. F. C. Daniel, had returned from leave and taken over charge of St. Coombs Estate on 3rd May, 1951 ;

(*b*) the Director, Mr. J. Lamb, had left St. Coombs on 2nd June, 1951, for home leave.

The meeting terminated with a vote of thanks to the Chair, proposed by Mr. Hurst.

(Sgd.) G. B. PORTSMOUTH,
Acting Secretary.

Tea Research Institute of Ceylon,
St. Coombs,
Talawakelle.

NOTICES.

The Institute's Laboratories and Offices are situated at St. Coombs, Talawakelle, and all applications and enquiries should be addressed to the Director, Tea Research Institute, St. Coombs, Talawakelle.

Specimens and other consignments sent by rail should be forwarded to Talawakelle Station c/o Messrs. M. Y. Hemachandra & Co., Forwarding Agents. *Carriage should be pre-paid.*

Visitors' Days The *second* and *last* Wednesdays in each month have been set aside as Visitors' Days, at St. Coombs Estate and also at the T. R. I. Sub-Station, Gonakelle Estate, Passara, when it is hoped anyone interested will visit the Stations.

Rules for the Occupation of St. Coombs Guest House

(1) The Guest House is normally intended for the use of persons visiting the Institute and St. Coombs Estate on business. Children can in no circumstances be accommodated.

(2) Permission to occupy a room for the night must be obtained from the Director in writing and, unless sufficient notice be given, accommodation cannot be guaranteed.

(3) All visitors must sign the Visitors' Book on arrival.

(4) A bedroom may not be occupied for more than one night if required by another visitor. This shall not apply to Members of the Board or of Committees meeting at St. Coombs who shall also be entitled to priority in the allocation of accommodation when on official business.

(5) Complaints or suggestions shall be entered in the book provided for the purpose and not made to the Guest House Staff. All payments due for services rendered shall be made in *cash* to the Guest House Keeper and a receipt obtained from him on the official form. The scale of approved charges is posted in the building. The Guest House Keeper is forbidden to give credit or to accept cheques.

(6) All breakages will be charged for at cost price.